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The Work of The United States Cotton Ginning Laboratory

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U.S. Department of Agriculture Miscellaneous Publication No. 445

A MODERN COTTON GIN

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THE PROBLEM

COTTON still belongs to the farmer while it is going through the ginning process. Most other farm products—milk, soybeans, fruit, vegetables, livestock, for example—leave the ownership of the grower before any processing starts. Therefore, as part of their quality-improvement programs, cotton growers are insisting that ginners handle and gin seed cotton so as to preserve all the quality that has been produced through improved varieties and cultural methods. They realize that a large part of the increased value as a result of their efforts toward crop improvement can be nullified during the few minutes it takes to gin a bale of cotton. Losses resulting from poor ginning are variously estimated up to $15,000,000 or more annually. Therefore, the cost to producers of inadequate and poorly operated gin machinery represents a tremendous yet largely avoidable loss.

THE UNITED STATES COTTON GINNING LABORATORY was established at Stoneville, Miss., in 1930, under an act of Congress authorizing ginning investigations. The work at the laboratory is intended to cover all phases of picking, handling, ginning, and packaging cotton with a view to developing improved methods and acquainting growers and ginners with these methods. It is directed toward better and cheaper ginning and the placing of good-

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The United States Cotton Ginning Laboratory at Stoneville, Miss., including fiber laboratories and machine shops, is the world's largest and most completely equipped of its kind.

quality cotton on the market. The Bureau of Agricultural Chemistry and Engineering is responsible for the engineering phases of the work at the laboratory and the Agricultural Marketing Service for the fiber technology and quality studies.

The Stoneville laboratory is equipped with virtually all standard makes and types of gin machinery. This equipment is installed so as to permit operation of each unit under wider ranges of conditions than would likely prevail in a commercial ginning establishment in any part of the Cotton Belt except the arid section. In most of the tests at Stoneville, conditions as they actually exist in the commercial gin plant are faithfully reproduced. In other tests, measured variations are produced to show the effects these variations have upon grade, staple length, preparation, and spinning value of the ginned sample. The laboratory has complete technical equipment for checking the conditions under which tests are made and the results of those tests. The fiber laboratories are equipped for studying and determining the effects upon fiber qualities and sample preparation of the various conditions under which different seed cottons are ginned and of the condition of the seed cotton at the time it is ginned.

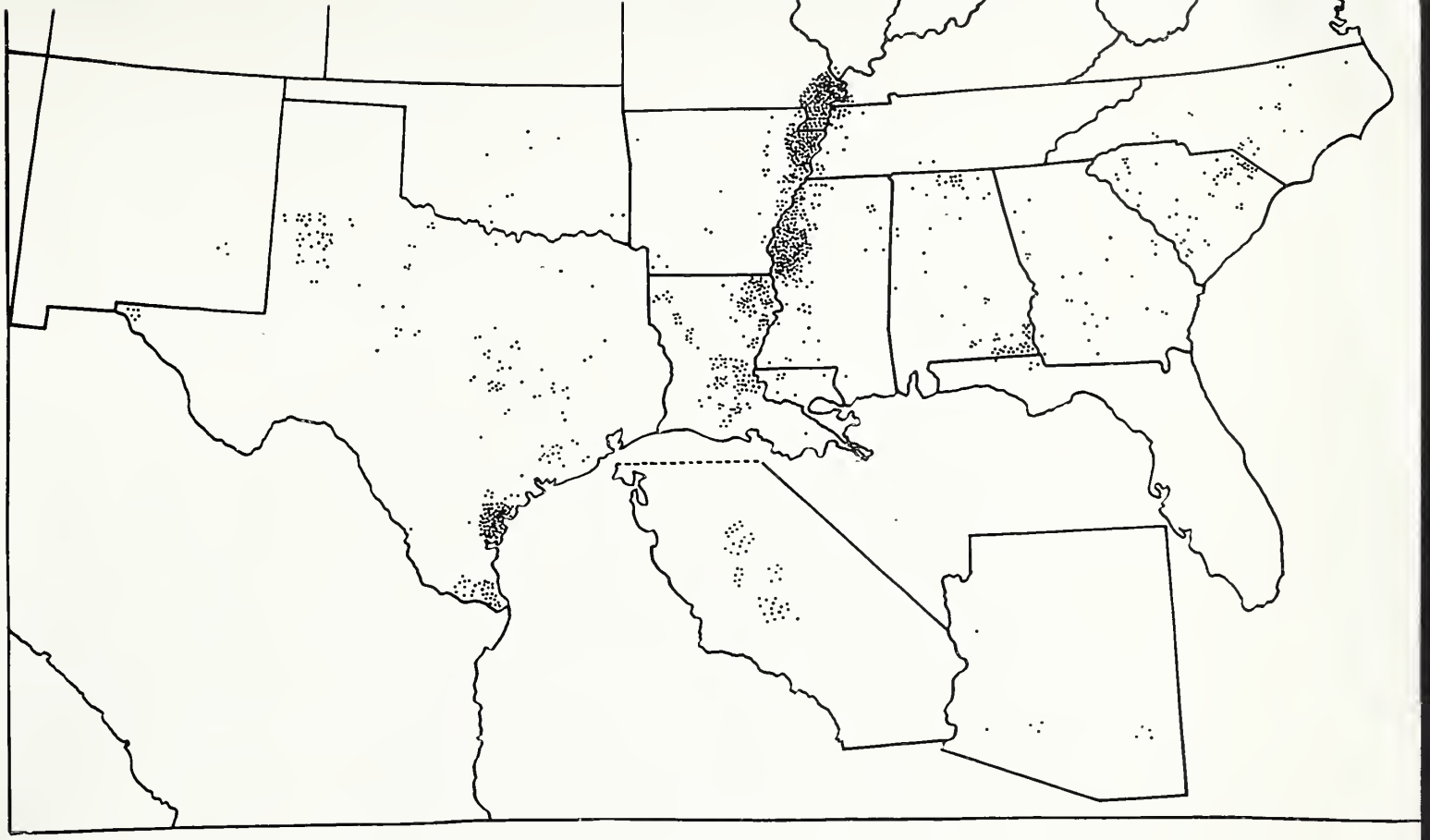
Condition of the seed cotton as it is delivered to the gin, both as to moisture content and amount and type of foreign matter, has much to do with grade of the lint as it comes from the gin stands.

Tests show that in picking cotton carelessly much trash is included and losses will range up to $5 a bale. Modern cleaning, extracting, and conditioning machinery can, of course, remove a considerable portion of this trash before

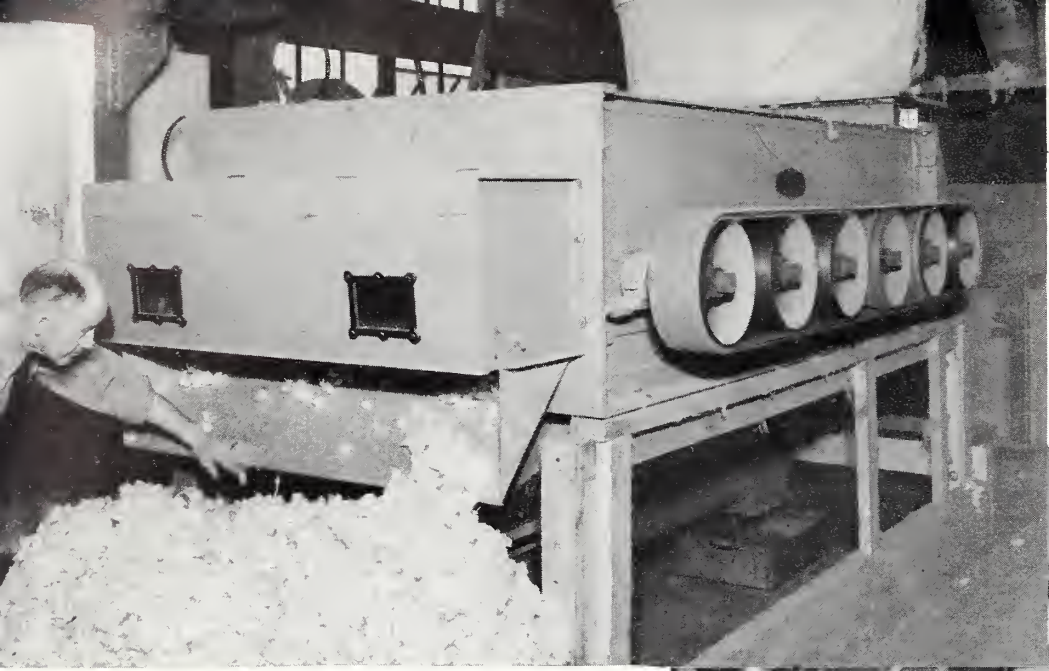
the seed cotton reaches the gin stands. However, tests show that even the most elaborate cleaning equipment has not thus far been able to entirely offset the effects of careless picking. Prompt and careful picking are essential to good ginning.

MECHANICAL DRIERS

CONDITIONING and drying of damp, green, or wet seed cotton, as recommended by the United States Cotton Ginning Laboratory, has been found to increase the value of the ginned lint from 70 cents per bale on short cottons to $2.50 on the longer staples, as well as to enhance the germination and milling qualities of the seed, with fuel costs frequently amounting to less than 15 cents per bale. Mechanical driers developed at the laboratory are now used in more than 10 percent of all gins. United States Patent No. 1,871,773 has been issued as a public-service patent under which the advantages of mechanical drying of seed cotton before ginning are made available, gratis, to the public.

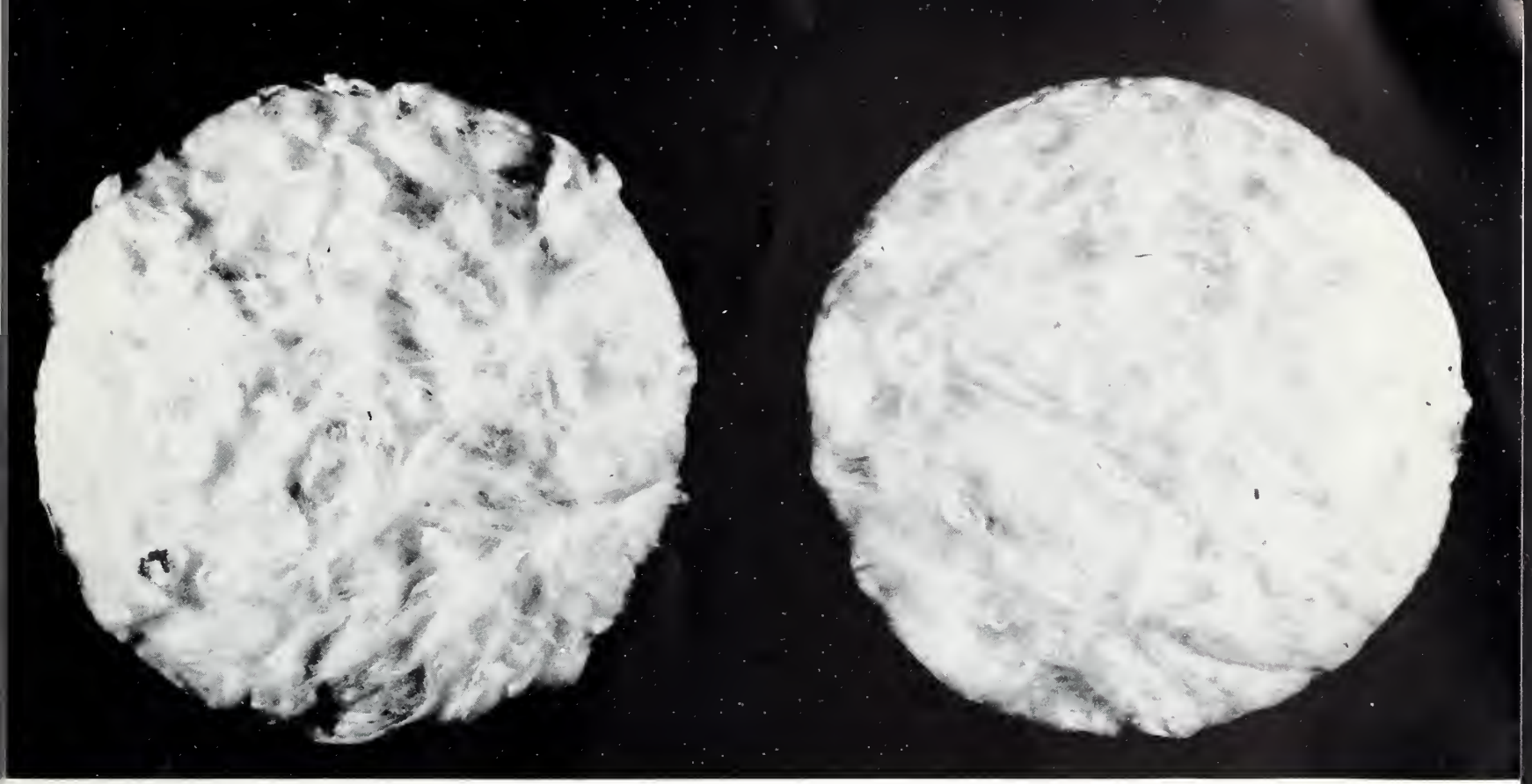


Distribution of cotton driers, 1940–41. Each dot represents a drier that handles from 500 to several thousand bales of cotton a season. More than 1,300 driers were in use in the 1940–41 ginning season.



All types of cleaning and extracting machines are tested. The past years have brought much more general use of modern cleaning equipment, especially extractor-cleaner feeders.

Tests have enabled the laboratory at Stoneville to recommend the best types of cleaning equipment for different conditions of seed cotton and gin operation.

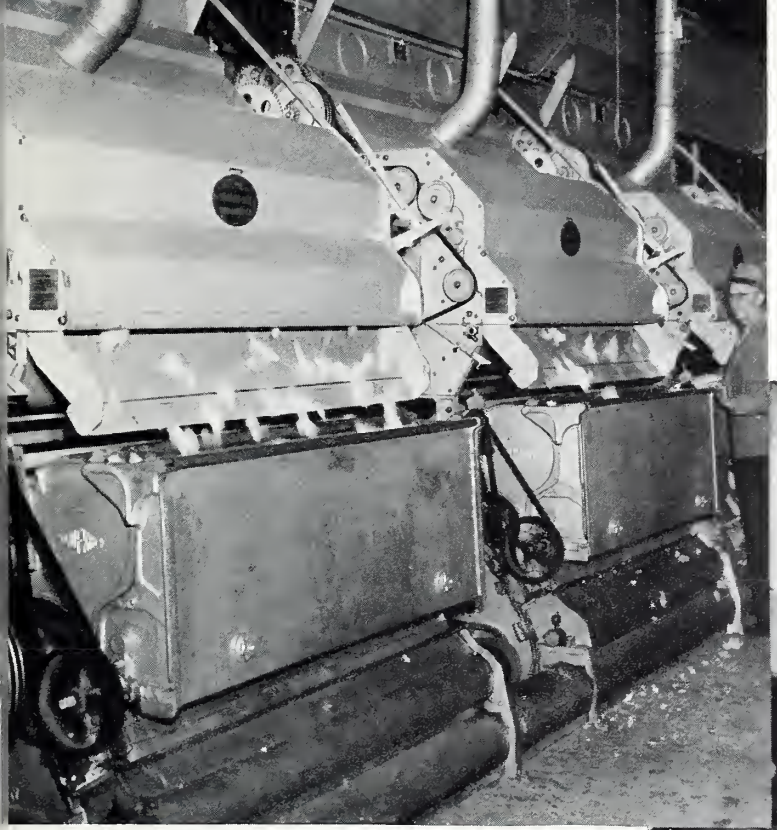


Recommendations of the United States Cotton Ginning Laboratory engineers and cotton technologists enable ginners to remove the causes of poor preparation and lowered market value resulting from poor ginning. The sample on the left, ginned wet, shows rough preparation; that on the right, dried before ginning, smooth preparation.

SAW SPEEDS AND SEED ROLLS

TESTS at Stoneville with seed cottons of widely varying types and under a wide range of ginning conditions show that the speed at which gin saws are operated has a marked effect upon both gin capacity and preparation of the ginned lint. Tests over a period of years on approximately 100 different cottons, varying widely in staple length, foreign matter, moisture, and other conditions and qualities, show that increasing the saw speed from 400 to 600 revolutions per minute and ginning with loose seed rolls will increase gin capacity almost 20 percent on both the long- and short-staple cottons. This increase in saw speeds and ginning with loose seed rolls has increased bale weights approximately 20 pounds on long-staple cottons and 15 pounds on short-staple cottons. In terms of bale values, this additional outturn of lint amounts to more than $2.50 a bale on the long-staple cottons and $1.50 a bale on short-staple cottons. The benefits from increasing the saw speed in ginning with loose instead of tight seed rolls have ranged up to $4 a bale on long-staple cotton.

The cost of increasing saw speeds amounts only to about $20 a gin stand for the new pulleys needed, or to approximately $35 a stand where new saw-shaft bearings are required to handle adequately the higher speeds. These costs are relatively negligible, considering the benefits resulting from increased capacity and better preparation of the ginned lint. In the Mississippi Delta alone, during the 1940–41 ginning season, 1 out of every 10 gins was speeded up to operate with higher saw speeds and loose seed rolls. Comparable improvement is reported from other areas of the Cotton Belt in which ginners have followed the recommendations of the Stoneville laboratory.



Interior of gin stand showing loose seed roll. Maintaining a saw speed of 600 r. p. m. or higher produces a loose roll and results in quality ginning and increased turnout and capacity.

Feeding for loose seed-roll ginning, recommended by United States Cotton Ginning Laboratory.

RECOGNITION

(Recognition accorded work at United States Cotton Ginning Laboratory and results)

THE extent to which the work of the United States Cotton Ginning Laboratory has attracted the interest of both cotton growers and ginners is attested by the large numbers of growers, ginners, and others who have voluntarily come to Stoneville to study its developments or who have otherwise asked the laboratory personnel to assist in solving ginning problems.

Groups of ginners and growers from a number of the important cotton-growing States have visited Stoneville, many of them periodically. These visiting groups, usually from 40 to more than 100 at a time, have spent from one to several days at the ginning laboratory. During their stay, they have observed the operation of various types of gin machinery and have had explained to them the operation and maintenance of the different units. They have asked questions as to the solutions of their own problems and have visited modern commercial gins in the vicinity of Stoneville where the developments of laboratory engineers have been applied to commercial operations.

The ginning laboratory serves as a training school for State extension specialists who have now been appointed in most of the cotton-growing States. These specialists come to Stoneville for a week nearly every spring. During their visit they go over the results of tests and studies of the preceding season. They discuss in detail the findings and conclusions, as well as resulting recommendations. Specific problems that have arisen in their respective States are presented for round-table discussion and for recommendations, both by other State specialists and by the research engineers and technologists of the laboratory. These conferences have served as a clearing house for the discussion of gin problems arising in all parts of the Cotton Belt and under all conditions of operation.

The State extension specialists on gins distribute information on approved picking, handling, and ginning practices in their respective States. Special assistance is rendered by the personnel at the research laboratory upon request from any State gin specialist. It has been possible, also, to provide this service to many individual ginners and farmers.

General information is disseminated over the entire Cotton Belt by means of published bulletins, leaflets, and circulars dealing with specific phases of equipment, maintenance, and operation of gins. Information also is furnished through radio broadcasts, in which members of the laboratory staff and individual State extension specialists on gins participate. These broadcasts, written for the cotton grower, as well as for the ginner, enable the broadcasters to spread their messages over a large territory just when their information is most needed, and with a minimum of travel and expenditure of time.

The findings of the laboratory have been put to practical use by the leading manufacturers of cotton-gin equipment. For example, all gin-equipment manufacturers now recognize the advantage of increased speeds for modern gins in terms of improved cotton quality and economy of operation. On the basis of laboratory reports, seed-roll boxes and gin saws have been redesigned, with resultant benefits to farmers and ginners. Approximately 150 new complete gin outfits having these and other improvements were installed in preparation for the 1940–41 ginning season, and more than 1,300 cotton driers—developed through research at the laboratory—were in operation in that season at gins throughout the Cotton Belt.

Selected samples of cottons ginned at Stoneville are used by the cooperative Federal-State spinning laboratories at Clemson College, S. C., and at College Station, Tex., in actual spinning tests. These tests determine the spinnability of each sample as regards waste and yarn properties for the purpose of further evaluating the effects of different ginning practices in terms of spinning qualities of the ginned lint, and of giving a sound basis for recommendations as to types of gin equipment and operation.

SAW DESIGN AND MAINTENANCE

GIN-SAW design and condition of the saws have been found to cause wide variation in preparation and value of the ginned lint. Studies at Stoneville have developed specific information as to the relative merits of different designs of saw teeth and different spacings of the teeth on the saw and the effects of varying degrees of wear. Specific recommendations have been made both as to design and maintenance of gin saws. These recommendations are now being followed by all gin manufacturers and by a large number of ginners who are endeavoring to do the best possible lint-preparation job for their customers.

BRUSHES

Repair of brush drums and replacement of worn or cut brushes assure proper doffing of the lint and a bale-value increase of as much as $1.50.

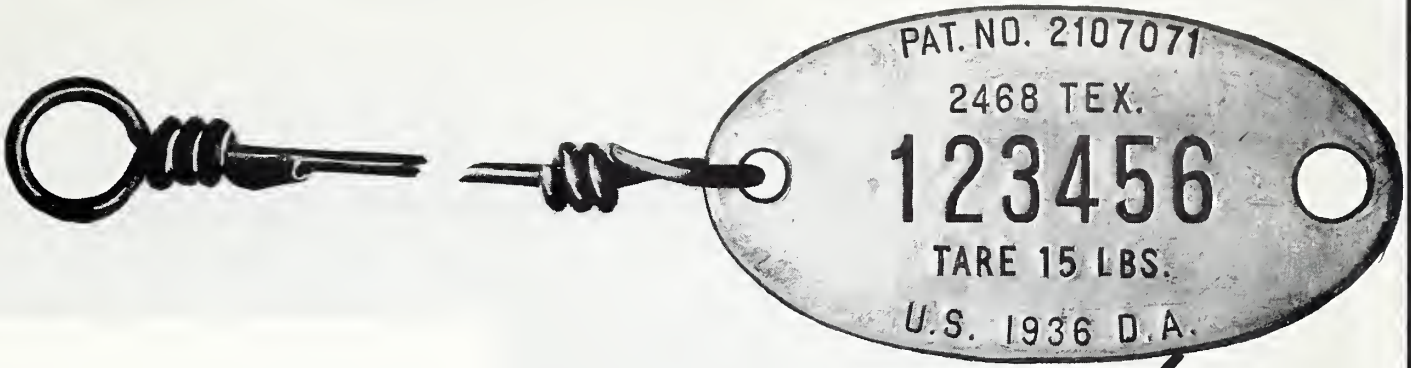
Condition, speed, and balance of the brush cylinders affect ginning efficiency and quality of the lint. Cut or worn brushes (top and middle) do a poor job of doffing. New brushes (lower) show recommended alinement of bristles.

PACKAGING

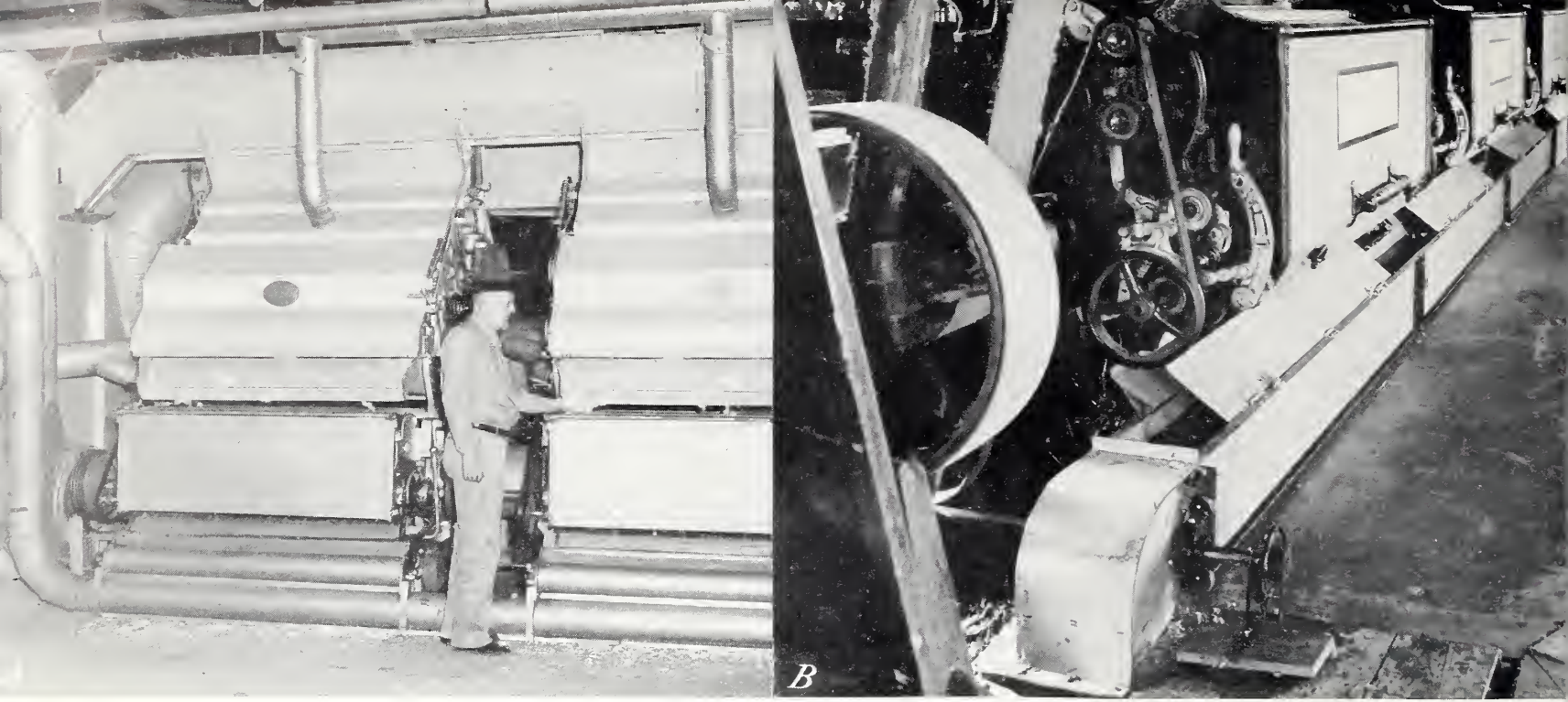
SERIOUS complaints received from users of United States cotton in various parts of the world as well as in this country over a number of years as to the unsightly appearance of bales and lack of adequate protection afforded them, have resulted in tests at the laboratory to determine the relative merits of various bale coverings and bale densities. The studies have extended to the effects of various ginning practices upon uniformity of bales, size and appearance, and uniformity of the lint within the individual bale.

Studies show that compression cuts, or so-called air cuts, and mutilation of bales can be reduced. To do this, however, attention must be given to the condition of the farmer's cotton, to the size of the bale, to the method of packing, from the standpoint of uniformity of density throughout the bale at the gin, and to the condition and manner of operation of the compress equipment.

Inability of mills and other users of raw cotton to trace improperly packed and otherwise objectionable bales to their source has been a frequent cause of complaint. To make possible permanent identification of bales, the Department has perfected a metal tag which can be securely anchored in the bale in such a manner as to prevent its loss or damage during the process of compression and during handling from gin to market. This tag is legible even after the bale has been destroyed by fire.



Permanent Identification Tag for Cotton Bales.—Actual Size. Over-all length of anchoring wire is 28 inches. The wire penetrates about one-half the length of the bale. These tags stay with the bale from the gin to the breaking room at the mill.



PURE SEED HANDLING SYSTEMS

THE swing to one-variety cotton has intensified the need to prevent mixing of seed at the gin. Different types of seed-handling equipment have been tested at Stoneville. Single-variety ginning has proved advantageous to both the ginner and the farmer. The laboratory has tested and recommended methods by which farmers may be assured of getting their own seed, even when the ginner handles different varieties of cotton, and the laboratory is giving attention to the development of better methods. The most popular of these methods are the blow-pipe *A* and the seed-belt arrangements under the gin stands *B*. Even with these modern pure-seed handling systems some time is required to clean the distributor, feeders, and other units in the gin for positive assurance against seed mixing.

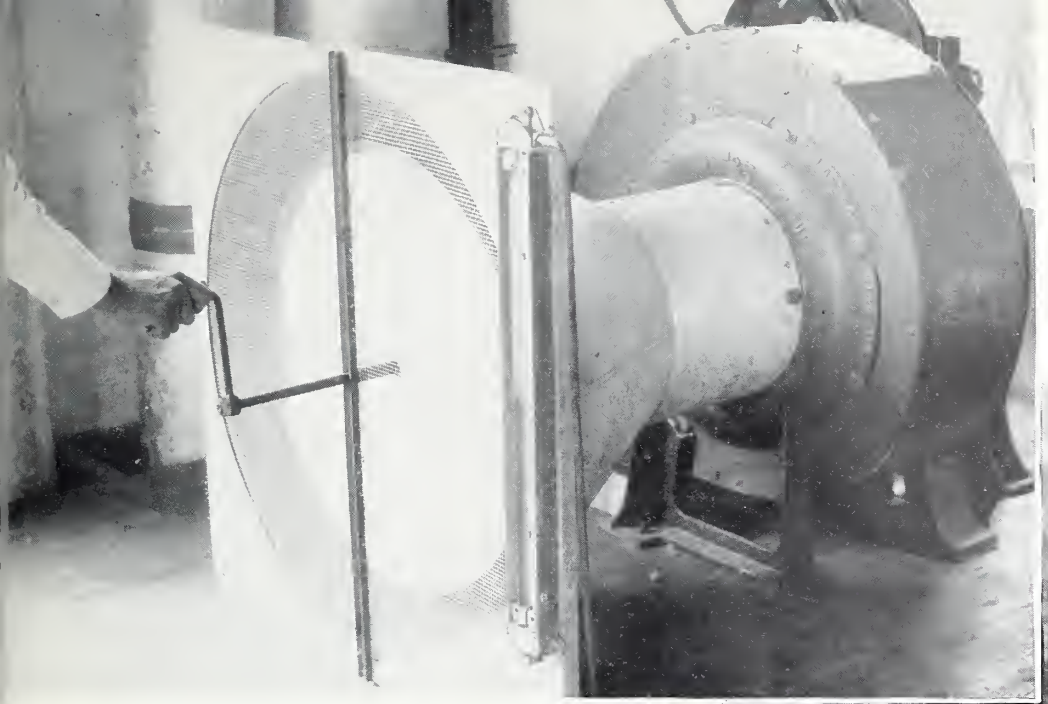
Studies of weather damage to cotton show rapid deterioration of fiber quality and market value. Photographs show various methods of storing: *A*, Unsheltered cotton stored on ground level; *B*, baled cotton used in weather-damage studies at the United States Cotton Ginning Laboratory; *C*, cotton stored in sheltered open shed; *D*, cotton stored in sheltered enclosed shed.

REDUCING POWER WASTES

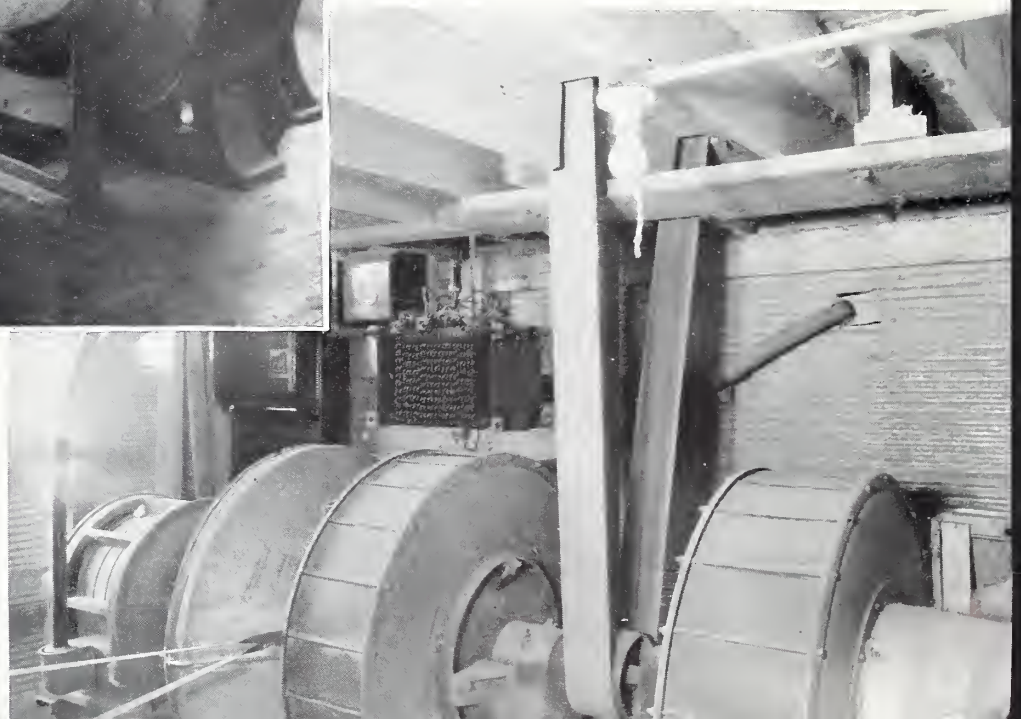
POWER represents a major item of expense in every cotton gin. Studies at Stoneville and observations at a large number of commercial gin plants have shown that waste power represents a considerable item of expense at many gins, and one that is difficult to measure except through a properly engineered study of the individual gin.

From these studies and recommendations resulting from them, many ginners have been able to change their piping and fans or to change the operation of their fans in such a manner as to effect material savings. Major savings in power used by fans were made by lowering fan speeds, repairing fans, reducing separator air losses, correcting the size of cotton-handling pipes, repairing leaky pipe connections, reducing the number of elbows in piping, substituting improved methods of handling seed for the unloading-fan-exhaust blow method, adding gages and control devices on fan inlets for regulating air requirements, and using improved drives and bearings in operating fans. These savings can be reflected to farmers either through improved ginning service or lower charges for service, or both.

Aside from any improvement in quality, developments that tend to decrease ginning costs are important, as these costs amount to approximately 10 percent of the total farm value of cotton lint.



Fan power is proportional to the volume of air handled. Device at left, designed at Stoneville, economically regulates amount of air delivered by the fan without requiring changes in fan speed.



Gin fans use plenty cf power, often much more than is needed to insure good service. Size and design of piping affect the loads placed upon fans.

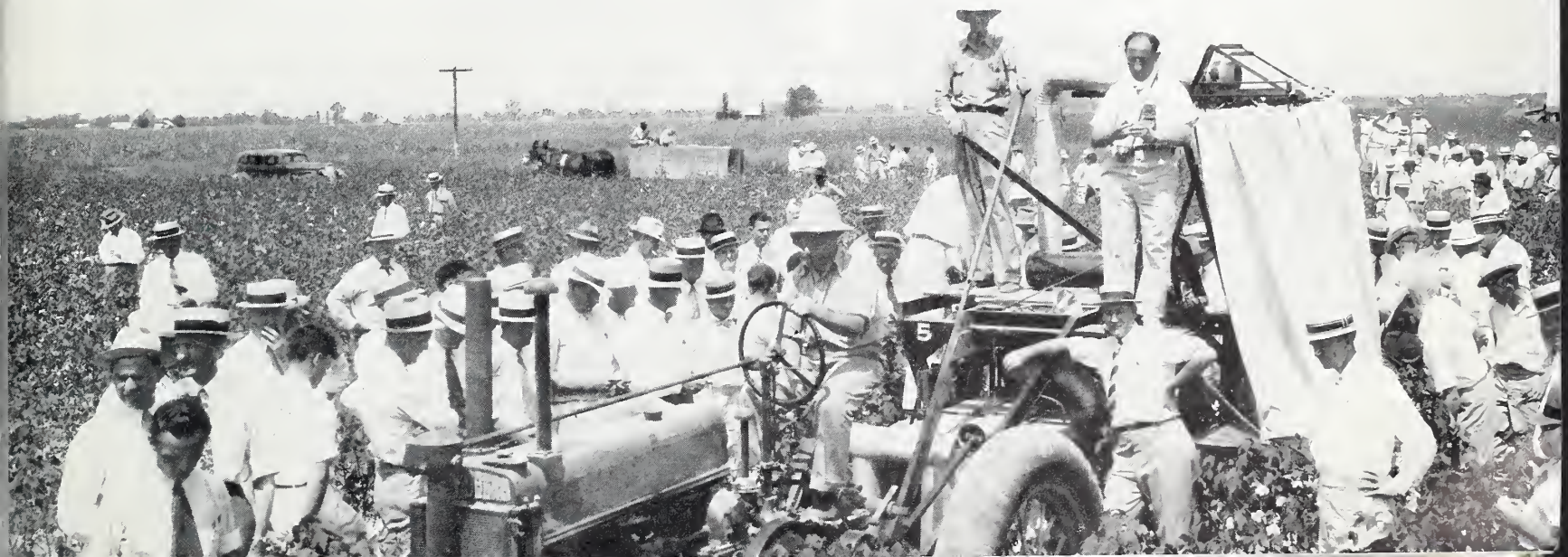
SPECIAL PROBLEMS

MANY special problems, largely of a regional or individual nature, are being studied by the laboratory. An outstanding example of these special problems is the occurrence in the arid regions of the West of gin chokages, with resulting damage to cotton fibers and reduction in gin capacities. These chokages and damage have been traced to the effects of static electricity. The laboratory is attempting to devise practical methods for eliminating either the cause or effects of these chokages and the resultant damage to the ginned lint.

Static electricity and other things have prevented the ginners in the western irrigated area from adopting the lint doffer developed by the laboratory for improving the efficiency of roller-ginning and the smoothness of the lint. The laboratory is studying the problems there with a view of overcoming the obstacles to the use of the doffer, which is used in sea-island cotton ginning in Georgia and Florida, where static is seldom prevalent. These roller-ginning studies are being supplemented by investigations of the many other roller-gin problems in these areas.

LOOKING AHEAD

NEW ginning problems would come with general use of mechanical cotton pickers. The laboratory has studied both the operation of mechanical pickers and the seed cotton harvested. This mechanically picked seed cotton, which contrasts sharply with hand-picked seed cotton as to trash content and general condition, creates special problems of cleaning and handling. As mechanical pickers come into commercial use, ginners will need information as to the best methods for handling and ginning mechanically picked cotton. Because of the occurrence of problems such as this, changing seasonal conditions, and mechanical developments, the programs of ginning research and extension are long-time and continuing ones.



PUBLIC PATENTS—

issued on equipment and improvements developed and tested by the United States Cotton Ginning Laboratory staff assure availability of these inventions to ginners in all parts of the Cotton Belt.

PATENTS

Patent number	*Title*	*Date granted*
1,695,991	Seed Cotton Drying Apparatus	December 18, 1928
1,707,929	Process and Apparatus for Drying Seed Cotton	April 2, 1928
1,707,930	Seed Cotton Drying Apparatus	April 2, 1928
1,827,183	Process and Method for Ginning Cotton With Air-Blast Gins	October 13, 1931
1,871,773	Apparatus for Drying Seed Cotton	August 16, 1932
2,002,974	Fractionation Device and Method for Employing the Same	May 28, 1935
2,045,064	Device for Culling and Grading Seed Cotton	June 23, 1936
2,078,309	Apparatus for Drying Seed Cotton	April 27, 1937
2,088,237	Holders for Bale Identification Tags	July 27, 1937
2,151,404	Apparatus for Determining the Moisture Content of Air Pervading Fibrous Material	March 21, 1939
2,107,071	Permanent Bale Identification Tag	February 1, 1938
2,156,893	Cotton Sampler Apparatus	May 2, 1939
2,156,894	Cotton Sampler for Cotton Condensers	May 2, 1939
2,173,071	Machine for Sampling Cotton	September 12, 1939
2,189,099	Drying Systems for Seed Cotton	February 2, 1940
2,196,613	Apparatus for Determining the Percentage, by Weight, of Linters on Cottonseed	April 9, 1940
2,225,397	Cotton Fan	December 17, 1940

PUBLICATIONS—

Results of the work of the United States Cotton Ginning Laboratory and recommendations by its engineers and technologists are incorporated in many printed and processed publications, a partial list of which follows:

PRINTED PUBLICATIONS[1]

Farmers' Bulletin No. 1748, Cotton Ginning.
Farmers' Bulletin No. 1802, Modernizing Cotton Gins.
Miscellaneous Publication No. 239, The Vertical Drier for Seed Cotton.
Miscellaneous Publication No. 314, Overhead Cleaner-Drying Systems for Seed Cotton.
Miscellaneous Publication No. 385, Sources of Heat for Cotton Drying.
Circular No. 393, Care and Maintenance of Cotton-Gin Saws and Ribs.
Circular No. 467, Care and Repair of Cotton-Gin Brushes.
Circular No. 510, Air-Blast Gin Performance and Maintenance.
Circular No. 601, Reducing Power Waste in Operating Cotton Gins.
Circular No. 621, A Practical Seed-Cotton Moisture Tester For Use at Gins.
[2] Leaflet No. 151, Effects of Feeds and Saw Speeds on Cotton Turnout and Quality. 5 cents.
Leaflet No. 169, Preventing Gin Damage to Cotton.
Leaflet No. 181, Drying Seed Cotton.
Leaflet No. 211, Cotton from Boll to Bale.
[2] Technical Bulletin No. 503, Effects of Gin-Saw Speed and Seed-Roll Density on Quality of Cotton Lint and Operation of Gin Stands. 10 cents.
[2] Technical Bulletin No. 508, Effect of Artificially Drying Seed Cotton Before Ginning on Certain Quality Elements of the Lint and Seed and on the Operation of the Gin Stand. 10 cents.
Technical Bulletin No. 663, Effect of Cleaning Seed Cotton on Lint Quality and Ginning Efficiency.

[1] Available from Office of Information, U. S. Department of Agriculture.
[2] For sale only by the Superintendent of Documents, Government Printing Office, Washington, D. C.

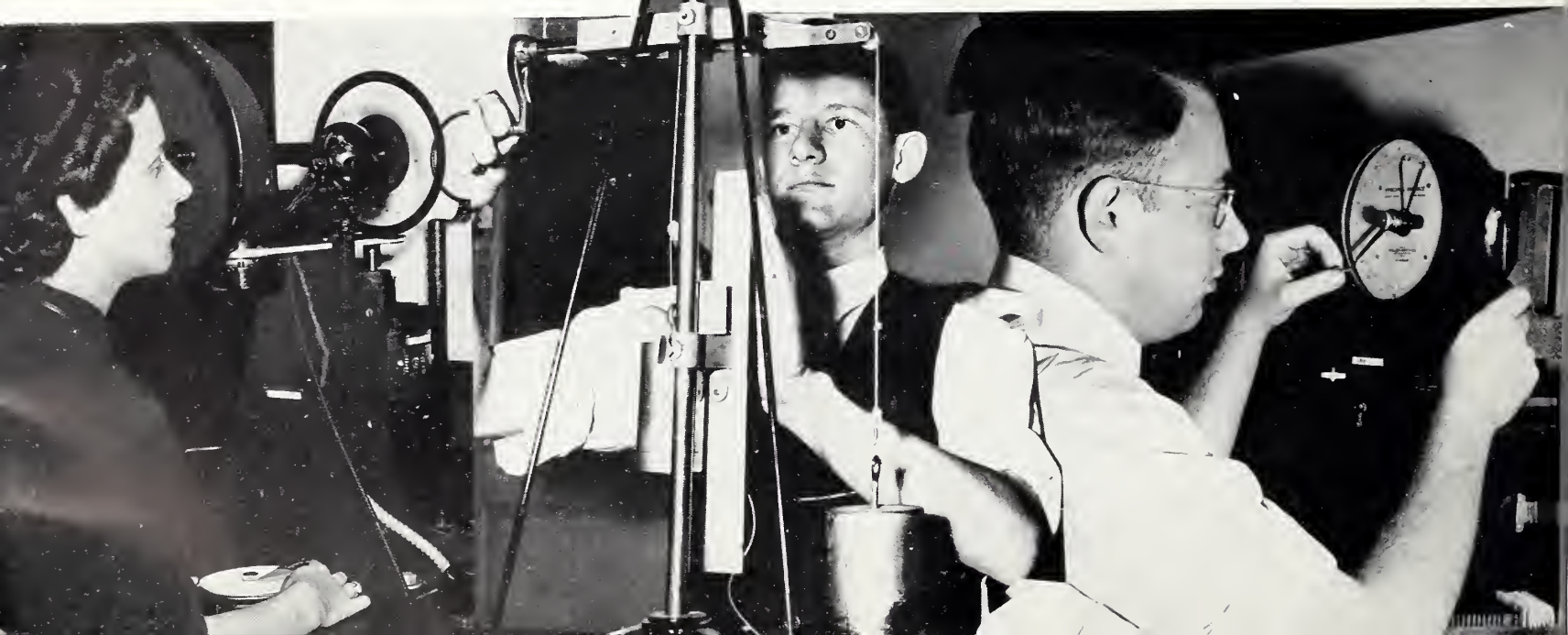
MIMEOGRAPHED ARTICLES[3]

Cotton Gin Operating and Testing Equipment.
Cotton Harvesting and Handling.
Fragments from the Chalazal End of the Cotton Seed.
Effect of Variations in Design of Gin-Saw Teeth on Lint Quality and Ginning Efficiency.
Roller Gin Construction, Maintenance and Operation.
Sea-Island Cotton Quality and Ginning.
The Compression of Cotton and Related Problems.
Permanent Identification of Cotton Bales.

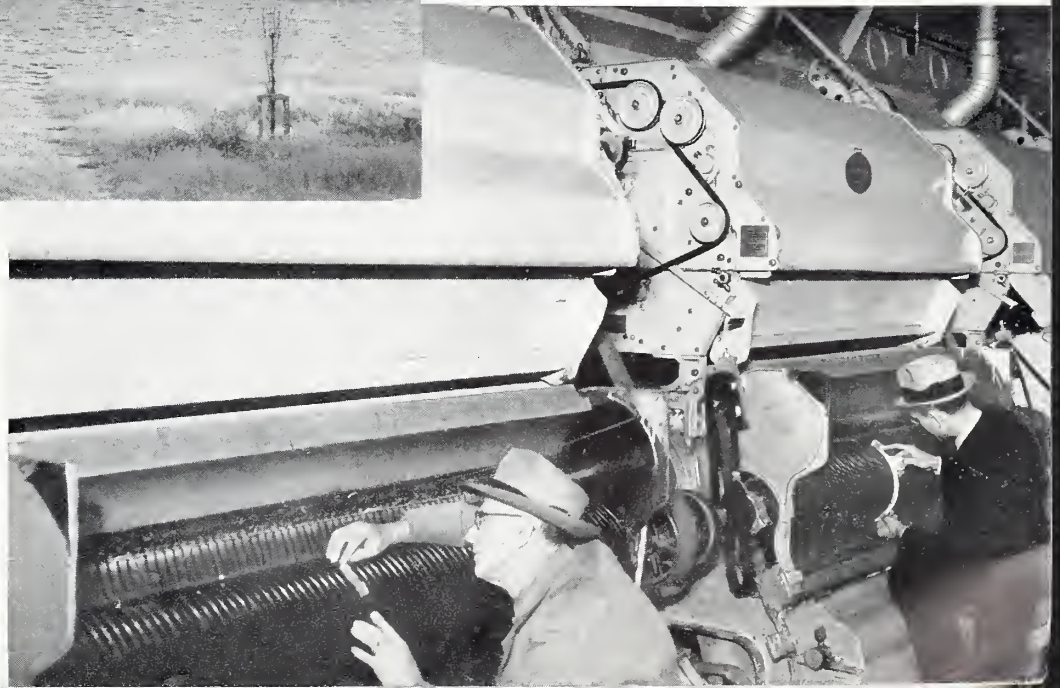
[3] Available from Agricultural Marketing Service, U. S. Department of Agriculture.

LABORATORY WORKERS—

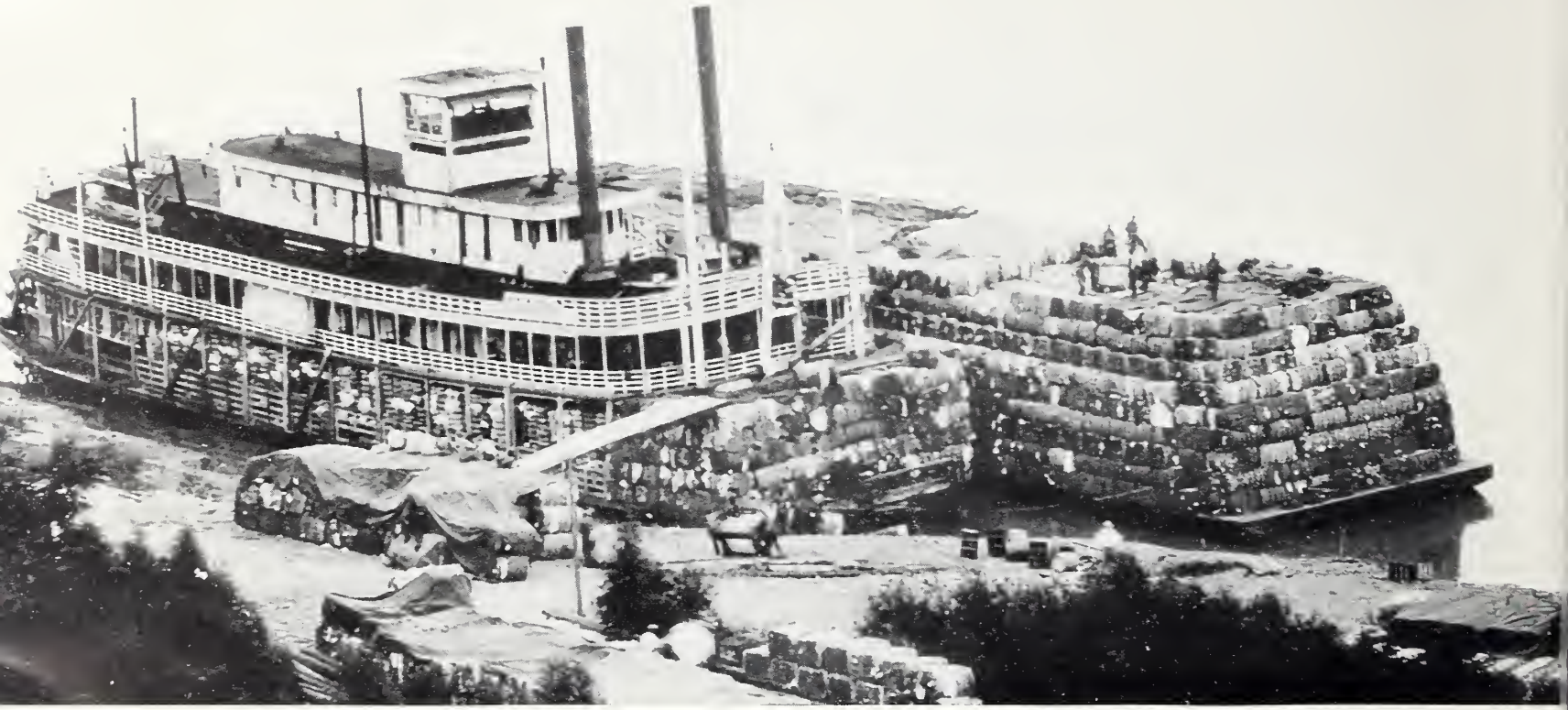
Study color, length, strength, and other properties of cotton fibers as they affect the spinnability and market value of cottons handled under different conditions of harvesting and ginning.



Modern all-steel plantation gin equipped with improvements resulting from laboratory findings.



Inspecting a plantation gin in which laboratory improvements were installed.



Load of cotton bales on the lower Mississippi. The work of the laboratory is improving the quality of such loads.

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